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Industrial Medicine and Industrial Toxicology*

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CHEMISTS are constantly devising new chemical methods that are being applied to industrial operations. They are creating new compounds and finding uses for compounds that, although not new, have in the past been used almost negligibly. Along with these newer methods they are creating new health hazards and problems of toxicology concerning which little or nothing is known.

Modern civilization demands that we improve the old methods by which our workmen were made ill and died by the score, and that we devise adequate methods of preventing occupational poisonings and diseases. Therefore, it becomes necessary that chemists and physicians become more closely associated in order that we develop sufficient knowledge concerning the development of these health hazards, and with this knowledge institute protective measures which will make all operations safe.

It is obvious that we are facing a complicated problem that must be worked out by the clinician and the toxicologist. Industrial medicine is not simply the treatment of occupational diseases and intoxications, but includes that which is more important—medical methods for the prevention of these diseases. Occupational diseases occur as a result of exposure to toxic substances and lack of proper medical supervision. Some of these diseases are the result of years of exposure and cannot be cured; for example, silicosis, a disease in which clinical symptoms do not appear until there has been extensive tissue damage. This damage is progressive and incurable. There are industrial diseases that are sudden in onset and terminate in death in a few hours; in this class we have chlorine poisoning, which causes an acute respiratory disease. There are acute occupational diseases which appear almost immediately after exposure, run an acute course for a period of twelve to forty-eight hours, and clear up in a few days. Aniline and nitro-benzene are examples of substances which cause this type of illness by their action upon the red blood cells, forming methemoglobin, followed by the destruction of many millions of the cells. I could cite other examples of industrial intoxications, most of which have developed with the progress of industry and have been recognized as the result of bitter human experiences, inestimable suffering and often death.

Industry must realize that the previous methods of trial and error are no longer acceptable, neither are they economical. Further, we must develop accurate knowledge of health hazards before operations are started. Operative procedures must be designed to prevent toxic exposure, and industrial health must have adequate medical protection.

The toxicologist, by proper methods of animal study, can develop the toxicity of a compound and the mechanism of action. From these facts he can point out both the precautions necessary for safe operation and the clinical symptoms which indicate beginning poisoning. With this information the industrial physician can establish adequate methods of medical supervision, organized on three basic principles; viz, proper selection of all employes, special medical protective examinations, and treatment of occupational diseases.

The pre-employment physical examination is the only means of making the proper selection of employes. There are many compounds used in industry which are toxic and under certain conditions may cause sudden death. Other compounds are toxic to a lesser degree, act more slowly and produce chronic disease—some in a short time and others after years of exposure. Still other compounds have a selective action upon certain organs. For example, carbon tetrachloride interferes with the function of the heart muscle, especially if the heart muscle is affected by heart diseases. Phosgene, nitrous fumes and other irritant gases cause marked inflammation of the lungs and

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may aggravate an active or activate pulmonary tuberculosis. Organic disturbances of the central nervous system may be aggragated by such compounds as carbon disulfide and lead.

These are only a few of the possibilities which must be considered by an examiner in order that he may protect an applicant, who has an already established disease, from working with compounds that will aggravate or activate his condition. The examiner should have at his command all the modern diagnostic equipment for making urine analyses, blood examinations (including blood chemistry), blood counts, serum examination for syphilis, x-ray films of the chest and, in special cases, electrocardiograms and basal metabolism tests. The fact that the applicant to get work may try to conceal his weaknesses should be kept in mind for the applicant's own protection.

Unfortunately, there are too many industries today giving little or no consideration to such an examination and many others making no examinations. All too frequently the physicians making these examinations have little or no knowledge of factory conditions, job requirements and health hazards that exist.

The second step is adequate protection. This may be provided by two means—properly designed operative, protective measures and equipment, and periodic medical examinations. Protective equipment is an engineering problem that should never be planned until the toxicologist has pointed out all the health hazards that may exist, and before he can do this he must make a careful toxicological study, which should be completed while prospective operations are in the experimental stages. There are today many operations which should be improved. Some can be made safe with reasonable changes; others will require a complete change of operating equipment.

Periodic medical examinations are needed because mechanical equipment, no matter how perfect, rarely continues to remain so, and very often the first knowledge of its faulty function is the appearance of toxic phenomena in the employes. Secondly, there frequently arise new sources of contamination, sometimes from within the operation and sometimes from without. Thirdly, the human flesh is heir to many ills, some developing slowly, others rapidly, many insidiously. There are many chronic ailments that are never suspected until far advanced. Many of these can be detected early and at least improved by removing the individual from any source of possible toxic irritation.

The frequency of periodic examinations should be determined by the toxicity of the compound involved and the rapidity with which it may enter and attack the human body. Even workers who are not exposed to any known hazards should be examined once a year.

The treatment stage in a properly controlled industry should seldom, if ever, be necessary and then only in cases of accidents. An employe who is sufficiently poisoned to require treatment is in every case an admission of (1) faulty operation (2) a careless workman or (3) an accident.

Industrial toxicology offers the means of avoiding frequent repetition of our past experiences of human suffering, acute illness, chronic illness and death. With the aid of the toxicologist and the pathologist, we can eliminate from our industries occupational diseases and toxic processes. We can start all new operations with adequate protective measures and a scientific understanding of the toxic symptoms to expect, based upon our knowledge of the mechanism of their production.

It should be made clear, however, that the toxicological study of any compound involves a great deal more than the determination of the quantity required to cause illness or death. This information is valuable but it represents only the beginning of the investigation which should also develop information on how the compound enters the body, under what conditions, the manner in which it attacks certain organs, and the mechanism by which it produces the toxic action. The toxicity of a compound may vary with the conditions under which it is used. Therefore, we must know how and under what conditions the material is handled, temperatures to which it will be subjected, physical changes in the operation and the possible chemical changes which may occur. Then there must be a careful study of the effect of a compound upon the body organs, what does it do, and how does it do it? Individual susceptibility, age and sex, all are important factors.

This type of study requires the development of an extensive amount of knowledge, otherwise the practical application of toxicology to industry is of no practical value. Further, the successful application of industrial medicine is entirely dependent upon an exact knowledge of toxicology.

● COLORIMETER

The M-R-H Laboratories are placing on the market a colorimeter which, it is stated, can be used for checking the most minute differences in color and shades of dyed materials, setting up in a quantitative or mathematical form the differences between two similar colors in measurable terms. It is stated that dyes may be checked by diluting about one drop of dye solution with 400 c.c. of water and using as a test sample 60 c.c. of the resulting solution in a standard petri dish, placing the instrument over it, thus getting the color content in primary colors in per cent of the total content. This represents a color identification of that particular dye and the slightest variation from the specifications is said to be immediately discernible. Dyed materials may be checked in a similar manner. The first reading of the instrument is the density reading or the value of all the total reflected wave lengths of light. If further information is desired to determine what changes are necessary to bring the shades to match, color filters are used and a reading taken for each filter. Complete details may be had upon request.

Deterioration of

Pipe Line Fabrics*

By GORDON N. SCOTT[1] and SCOTT EWING[2]

I. PURPOSE AND PLAN OF TESTS

THE examinations of the fabrics in the coatings in the American Petroleum Institute and American Gas Association field tests indicate that many of the fabrics which are used to reinforce or shield pipe coatings lose their strength and sometimes disintegrate entirely. It was therefore proposed that a laboratory test to determine the durability of a variety of materials, which are or might be used for pipe line fabrics, be undertaken. Such a test would furnish quantitative data, which for various reasons could not be obtained from the field tests, on the change in strength of a wide variety of materials.

Several fabric manufacturers were accordingly asked to submit as many types of fabrics as they wished. Strength tests on these fabrics were made in the textile laboratory of the National Bureau of Standards, using the type of standard test which was best adapted to each type of fabric. The strengths of some of the woven fabrics and of all the felts and similar materials were measured using the so-called strip test. The strengths of the heavy woven fabrics were measured by the grab test and for the very heavy woven fabrics separate strands were removed and tested. In all these tests, the force in pounds which is required to break a sample, of a given size, held between jaws which separate at a specified rate is meas-

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TABLE I

Description and Properties of Materials

No.	Description of Material	Approximate Weight in lbs./100 sq. ft.	Approximate Thickness in Mils	Average Breaking Strength in Pounds (As Received)
				STRIP TEST
1	14 # asbestos felt, asphalt-saturated	13.9	26.7	42.0
2	15 # asbestos felt, asphalt-saturated	17.0	28.1	57.8
3	15 # asbestos felt, tar-saturated	14.6	29.5	62.5
4	14 # asbestos felt, tar-saturated	13.7	27.4	61.4
5	Same as 1 with bakelite resin saturant	12.4	25.9	50.9
6	15 # asbestos felt, tar-saturated	15.1	28.7	64.7
7	15 # asbestos felt, grease-saturated	15.8	28.6	35.2
8	15 # rag felt, asphalt-saturated	17.3	41.6	56.5
9	30 # rag felt, asphalt-saturated	32.3	69.8	65.8
10	30 # coated rag felt, asphalt-saturated	30.2	55.2	71.8
11	40 # coated rag felt, asphalt-saturated	47.4	96.8	81.4
12	15 # rag felt, tar-saturated	15.5	40.4	88.7
13	30 # rag felt, tar-saturated	26.8	65.2	71.3
14	Polymerized resin shield	5.5	10.5	82.4
15	Polymerized resin shield, paper backed	9.3	19.7	103.8
16	Cotton fabric with rot inhibitor, grease-saturated	8.7	21.0	39.9
17	Cotton fabric withoct rot inhibitor, grease-saturated	8.0	18.5	38.5
				GRAB TEST
18	Woven asbestos fabric, open weave, tar-saturated	21.5	73.0	61.5
19	Cotton fabric, asphalt-saturated	8.05	32.7	103.8
20	Cotton fabric, tar-saturated	8.25	33.7	97.2
21	Coir fiber, close weave	22.0	97.7	151.0
22	Burlap	7.8	26.0	141.7
				SINGLE STRAND TEST
23	Manila fiber	...	...	95.9
24	Manila fiber, creosote-treated	25.4	111.1	91.7
25	Hemp	46.5	188.1	139.7
26	Sisal	48.6	214.7	149.0

ured. All the fabrics were tested as received and also after they had been soaked in water 24 hours. They were allowed to remain in a conditioning room at a temperature of 70°F. and humidity of 65% for a period of at least 24 hours before being tested. All the fabrics, unexposed to the soil, were again tested as received and after soaking, at the completion of the tests to determine any marked change in strength with time due to the loss of volatile solvents.

The weight of each of the fabrics in pounds per square foot was determined. The approximate thickness of each

TABLE II
Results of Breaking Strength Tests

No.	*Breaking Strength in Pounds (As Received)* 2-27-34	1-7-35	*Breaking Strength in Pounds (After Soaking)* 2-27-34	1-7-35	*97 Days* Top	Bottom	*209 Days* Top	Bottom	*301 Days* Top	Bottom
	STRIP TEST									
1	41.2	42.2	38.0	41.2	32.6	30.8	39.4	33.4	34.2	35.6
	42.8		39.4		30.2*	27.6*	38.6	33.0	38.2	34.8
2	57.0	54.4	54.8	61.6	52.8	45.6	59.4	51.8	56.0	50.8
	58.6		56.0							
3	62.0	60.0	48.6	59.6	44.2	32.6	37.6	27.4	31.6	28.2
	63.0		48.0		41.6	28.2	36.8	22.4	35.2	24.6
4	56.6	58.4	52.4	66.8	74.0	68.4	67.8	52.4	65.4	44.2
	66.2	66.0	58.0	60.2						
5	51.8	70.6	33.6	58.8	28.0	33.2	54.8	31.4	26.2	22.8
	50.0		38.2							
6	69.3	74.2	56.2	66.8	69.3	69.7	69.6	60.2	59.4	56.8
	60.0	64.6	60.4	60.4			71.8	61.6		
7	34.6	37.4	34.8	34.0	27.8	18.0	24.2	14.3	24.0	15.6
	35.8		36.8							
8	56.6	57.2	53.0	54.2	17.0	7.2	12.8	8.6	20.2	11.4
	56.4		52.4		16.6*	6.0*	11.4	8.8	19.6	11.4
9	64.0	70.2	54.0	72.8	29.0	11.8	21.8	12.4	27.4	14.4
	67.6		58.2							
10	71.0	76.0	76.6	76.6	59.0	25.8	46.0	18.5	28.0	19.4
	72.6		77.0							
11	81.6	85.6	74.2	80.0	67.0	33.4	77.0	21.6	32.8	21.8
	81.2		80.2							
12	90.2	96.0	66.6	92.2	99.2	22.8	32.8	0.0	58.2	0.0
	87.2		57.8							
13	69.7	87.8	98.4	106.0	81.8	22.2	32.0	5.8	58.0	6.8
	72.8		97.0							
14	83.4	87.8	62.0	85.0	29.8	12.4	40.8	6.3	30.0	9.3
	81.4	90.2	74.8	80.8						
15	104.8	114.8	62.2	110.2	69.8	33.2	77.5	26.8	99.0	9.3
	102.8	121.8	66.4	116.4						
16	40.2	40.6	37.2	40.2	45.0	40.2	40.8	6.3	42.6	4.4
	39.6		41.8							
17	39.4	39.6	42.8	42.2	3.8	0.0	0.0	0.0	12.2	0.0
	37.6		42.6							
	GRAB TEST									
18	61.5	61.5	57.6	71.5	76.2	85.6	91.2	89.8	89.8	88.0
		71.5		74.8	94.8*	95.8*	86.6	77.0	94.3	91.5
19	103.8	102.8	100.0	100.0	23.5	0.0	0.0	0.0	0.0	0.0
					17.8	0.0				
20	97.2	110.5	98.5	99.7	10.3	0.0	0.0	0.0	0.0	0.0
					22.2					
21	151.0	153.3	93.8	127.8		116.2		54.0		0.0
						111.8*		101.8		0.0
22	141.7	148.5	157.5	124.3	26.8	0.0	16.7	3.3	0.0	0.0
	SINGLE STRAND TEST									
23	95.9	...	105.6	74.7		0.0		0.0		0.0
24	91.7	78.5	96.8	71.0		72.9		6.4		13.8
25	139.7	...	142.3	...		22.3		0.0		0.0
26	149.0	...	144.5	...		4.4		0.0		0.0

*Removed—6-6-34, tested 9-27-34.

was measured with a Randall and Stickney gage using a half-inch foot under a 100-gram load.

In Table I are given for all the fabrics tested a description of the material, the approximate weight in pounds per 100 square feet, the thickness in mils and the average breaking strength (as received) in pounds.

Three sets of samples of the fabrics, large enough so that at least five separate strength tests could be made on each sample, were then exposed to the soil. The fabrics were placed vertically in 10-inch cubical boxes, and the boxes were filled with soil. Each fabric was separated from the adjacent fabrics by about 1 inch of soil and the fabric extended about 1 inch above the surface of the soil. The soil was a dark brown clay loam, containing considerable organic matter, and was obtained from the flood plain of the Anacostia River near Washington, D. C. After the fabrics were placed in the boxes, water was added until the soil was practically saturated. Water was added at intervals of about one month thereafter. After standing for a month the soil was air dry to a depth of about 2 inches but was always moist in the bottom half of the boxes.

Sets of fabrics were removed and tested after periods of 97, 209 and 301 days' exposure to the moist soil in the boxes. The fabrics were carefully removed from the boxes, soaked in water for several hours and freed of soil with a soft fiber brush, conditioned and tested as previously described. The general appearance of the fabrics was also noted.

II. RESULTS OBTAINED

The complete average results of the strength tests are given in Table II. Each figure in the table is the average of at least five independent measurements. From 20 to 35 measurements are included in the averages for the fabrics in the strand test group. Some idea of the accuracy of the tests may be obtained from the duplicate sets of at least five measurements on the original samples. When the fabrics were removed from the boxes tests were made on both the top half and bottom half of each sample of fabric. If the fabric was affected at all the bottom half was always in worse condition than the top half.

In Table III are presented the results on the change in properties of the fabrics with time, soaking and exposure to soil. In columns 2 and 3 are given the ratios of the strength of the fabrics as received and at the completion of the tests. In column 3 are given the changes in weight of the fabrics on soaking and conditioning as percentages of the original weight. In column 4 are given the ratios of the strengths of the fabrics as received to the strengths after soaking in water and conditioning. The results in column 4 are averages of two series of

TABLE III

Change in Properties of Fabrics with Time, Soaking and Exposure to Soil

No.	*Ratio of Change in Strength with Time*		*Change in Weight (%) After Soaking*	*Average Change in Strength on Soaking*	*Ratio of Strength of Bottom-half of Specimens After Exposure to Original Strength**		
	As Received	*After Soaking*			*97 Days*	*209 Days*	*301 Days*
1	1.005	1.07	+0.38	0.95	0.73	0.83	0.88
2	0.94	1.11	+0.10	1.05	0.78	0.885	0.87
3	0.96	1.24	—0.68	0.88	0.56	0.46	0.49
4	1.01	1.15	—0.59	0.96	1.15	0.88	0.745
5	1.39	1.64	—0.64	0.77	0.70	0.66	0.48
6	1.07	1.09	—0.36	0.91	1.14	1.00	0.93
7	1.06	0.95	+0.46	0.97	0.515	0.41	0.445
8	1.01	1.03	+1.17	0.94	0.12	0.16	0.21
9	1.07	1.30	+1.94	1.00	0.18	0.19	0.22
10	1.06	1.00	+1.15	1.04	0.34	0.24	0.25
11	1.05	1.15	+3.94	0.99	0.40	0.26	0.26
12	1.08	1.48	—0.52	0.83	0.30	0.00	0.00
13	1.23	1.08	—0.24	1.29	0.22	0.06	0.07
14	1.08	1.21	—1.08	0.96	0.16	0.08	0.12
15	1.14	1.76	+1.66	1.01	0.37	0.30	0.105
16	1.02	1.02	+0.46	0.99	1.00	0.16	0.11
17	1.03	0.99	+0.74	1.09	0.00	0.00	0.0
18	1.08	1.27	—0.12	1.02	1.39	1.28	1.37
19	0.98	1.00	—0.41	0.97	0.00	0.00	0.00
20	1.14	1.01	—0.13	0.96	0.00	0.00	0.00
21	1.02	1.36	+0.07	0.73	1.03	0.70	0.00
22	1.05	0.79	+1.87	0.98	0.00	0.03	0.00
23	...	0.71	...	1.10	0.00	0.00	0.00
24	0.86	0.73	—0.37	0.98	0.87	0.08	0.16
25	...	...	+1.50	1.02	0.16	0.00	0.00
26	...	...	+2.17	0.97	0.03	0.00	0.00

*Based on weighted average strength after soaking using measurements of 2/34 and 1/35.

measurements made at installation and at completion of the tests. In the columns 5, 6 and 7 are given the ratios of the fabric strengths (bottom half) after exposure in the soil to the average strengths after soaking at the time of installation and at completion of tests. The results in columns 5, 6 and 7 are shown graphically in Fig. 1 and Fig. 2.

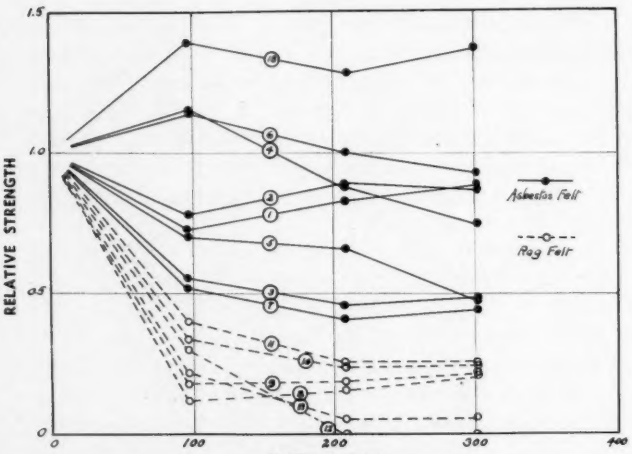

Fig. 1—Effect of Exposure to Soil on Strength of Fabrics.

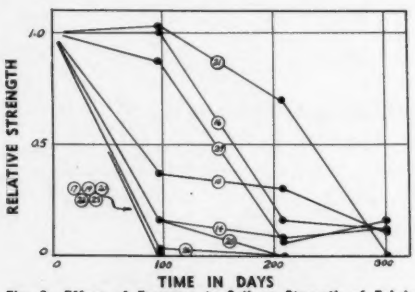

Fig. 2—Effect of Exposure to Soil on Strength of Fabrics.

III. DISCUSSION OF RESULTS

The fabrics in this test are directly exposed on both sides to the attack of the bacteria and fungi in a soil which is full of partially decomposed organic matter, and which is near the optimum moisture content and temperature for the rapid growth of these organisms. The fabrics would thus be expected to deteriorate much more rapidly than they would on a pipe line, where they are often completely covered with bitumen and are usually buried at a depth where there is little life in the soil.

Other things being equal, a coating having a non-rotting reinforcement or shield would be expected to be better than one in which the reinforcement or shield would rot if the conditions were favorable. These results afford some measure of the relative stability of the fabrics which were tested.

Exposure to the soil has caused a decrease in the strength of all of the fabrics, the only notable exception being the woven asbestos fabric (No. 18). All the asbestos felts are less affected by the soil than any of the other materials, as shown in Fig. 1. The decrease that is observed in the case of the asbestos fabrics is probably of no great practical importance. All the organic materials show an appreciable decrease in strength at the first removal and usually a further decrease at the subsequent removals. A few of them rotted so completely that they had no strength whatever. In fact in several cases it was impossible to recover intact from the soil a single square inch of material.

The use of creosote, tar, and other disinfectants delays rotting considerably but does not prevent it. There is little choice between asphalt and coal tar as a saturant for rag felts in so far as strength is concerned. The asphalt-saturated fabrics appear to absorb more water and become limp, which is not true of the coal tar-saturated felts. This fact is especially evident from the figures in column 3 of Table III. It will be observed that with the exception of No. 19 all the asphalt-saturated fabrics (Nos. 1, 2, 8, 9, 10, 11) increased in weight after soaking in water.

It will be observed from Table II that the wetting of the fabric before it is conditioned for testing in many cases has a marked effect on the strength. This effect is usually to decrease the strength although there are one or two exceptions.

● du PONT DYE

The Dyestuffs Division of E. I. du Pont de Nemours & Company, Inc., announces the development of "Lithosol" Fast Green B Paste (Patent applied for), which produces yellow shades of green, as an addition to its line of lake colors. It is of interest as a pigment for wallpaper printing as it is said to pass the twenty-four-hour Fade-Ometer test for wallpaper light fastness, and it is used as a pigment in printing inks. It is also claimed that "Lithosol" Fast Green B Paste can be recommended for use in the beater or as a coating product, combining good fastness with excellent working properties.

"Lithosol" is a registered trade-mark of E. I. du Pont de Nemours & Company, Inc.

● OCTOBER CHEMICAL IMPORTS

Rising commodity prices coupled with heavier receipts of many items resulted in imports of chemicals and allied products reaching the high value of $10,117,600 during October, an increase of 36 per cent over the preceding month and more than 50 per cent in advance of October last year, according to an analysis of preliminary statistics made public by the Commerce Department's Chemical Division.

Imports of coal tar products in October were valued at $944,480, $460,000 less in value than during the preceding month and $350,500 below October, 1934, the decline in each instance being due to smaller receipts of creosote oil. The value of coal-tar colors, dyes, stains, etc., imported in October amounted to $578,400, showing little change from the preceding month or the same month last year, statistics show.

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PROCEEDINGS OF THE
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DECEMBER 16, 1935

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Proceedings of the American Association of Textile Chemists and Colorists

Accelerated Aging Test For Weighted Silk*

By Wm. D. APPEL† and DANIEL A. JESSUP†

I. INTRODUCTION

IT is well known that silk deteriorates when exposed to daylight, becoming weak and brittle, and that the rate of deterioration depends not only upon the nature of the radiation and of the atmosphere about the silk, but also upon the substances present on it. Sizing, weighting, and finishing materials and even traces of acids, alkalies, salts, soaps, and oils left on the silk after processing, drycleaning, or laundering may influence the rate of deterioration materially. Some of these substances increase the rate, others decrease it. Therefore the extent of the deterioration to be expected in a given time cannot be predicted simply from the *amount* of weighting or other substances present in the silk.[1]

PREFATORY ABSTRACT

The rate at which silk and particularly weighted silk will deteriorate on exposure to light, heat, and moist air cannot be predicted simply from the amount of weighting or other substances present on the silk. A laboratory test which will indicate the relative stability of silks is needed.

The aging, as revealed by changes in breaking strength, of a variety of silk and weighted silk cloths when stored in the dark, when exposed to the daylight received through a north window (natural aging), and when exposed to the radiation from the glass-enclosed carbon-arc lamp under controlled conditions of temperature and relative humidity of the atmosphere (accelerated aging) was studied.

Data on the accelerated aging of some typical silk dress fabrics were obtained.

An accelerated aging test is proposed.

The deterioration can be accelerated in the laboratory by exposing the silk to radiation of relatively high intensity rich in the shorter wave lengths and by increasing the temperature and relative humidity of the air about the silk. If the relative stability of silks in this accelerated aging is indicative of the relative stability under "natural" conditions, laboratory exposures can be utilized in the development of protective finishes, in the control of the finished product, and in the specification of silks with respect to relative stability. The last is of especial interest to distributors and users of weighted silks.

In order to compare natural and accelerated aging, a study was made of the changes in breaking strength of a variety of silk cloths when stored in the dark, when exposed to the daylight received through a north window, and when exposed to the radiation from the glass-enclosed carbon-arc lamp under controlled conditions of temperature and relative humidity of the atmosphere[2]. The results are given in this paper.

II. MATERIALS AND PROCEDURE

The silk cloths used for the preliminary experiments were all made from the same piece of commercially boiled-off cloth. Eight pieces of it were prepared in different ways in mills regularly engaged in this work. One piece was the original boiled-off silk. A second piece was dyed, "pure dye" in the figures. Six pieces were weighted to different extents and dyed. The series of eight pieces

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†U. S. Bureau of Standards.

[1]References to some of the experimental work on the deterioration of silk which can be cited in support of these statements follow:

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[2]Although the aging of silk cloth is not fully represented by changes in breaking strength, this seemed to be the simplest criterion to use for these exploratory studies. The changes in elongation at break of the fabrics were determined but the results were somewhat erratic and are not reported.

thus processed is designated "dyed." A portion of each of the cloths of the "dyed" series was printed. A second portion of each of the cloths was discharge printed.

The silk cloths used for the confirmatory experiments were similar to those of the dyed series, just described, but were made from a different piece of silk cloth. Two sets were prepared, the boiling-off, weighting, and finishing being done in two different mills.

Each sample of cloth for natural aging was divided into two pieces. One piece was stored in the dark in a clothes locker. The other was hung in one of the large factory-type windows of the cotton mill at the National Bureau of Standards. The samples were placed about 4 feet from the north windows and were exposed continuously. All samples in the preliminary tests were exposed simultaneously and all in the confirmatory tests simultaneously. The samples were frequently interchanged in position in order, as far as possible, to insure comparability of exposure. The breaking strength in the warp direction of each sample was determined at intervals of time by the 1-inch strip method, averaging the results of 3 breaks. All samples were conditioned and tested in an atmosphere of 65 per cent relative humidity having a temperature of 70° F. (21° C.)

The temperatures in the storage locker and in the window where the samples were exposed were observed three times daily during the first month and the last two weeks of the preliminary aging tests. The average temperature in the locker was 28° C. and in the window 31° C. during the first month. During the last two weeks the average temperature in the locker was 22° C. and in the window 32° C. Thus the stored samples were at a lower temperature than the exposed.

The relative humidity of the atmosphere in the locker was that of the ordinary office room in which it was kept. The relative humidity of the atmosphere about the exposed samples was maintained at 70 to 75 per cent during a considerable part of the time, when the room was being used for spinning.

Accelerated aging was obtained by placing the samples in an insulated box having a glazed window facing the glass-enclosed carbon-arc lamp of the "Fade-Ometer."[3] The temperature of the air in the box was maintained at either 55° C. or 67° C. by a thermostat and the relative humidity was maintained at either 30 per cent or 75 per cent with saturated solutions of magnesium chloride and sodium chloride, respectively.[4] A motor driven propellor kept the air in the box well mixed.

III. AGING OF SILK UNDER NATURAL CONDITIONS

The aging indicated by changes in breaking strength of silk cloth finished in 24 different ways, in dark storage and in the radiation received through a north window, is shown in Figure 1. None of the fabrics decreased in strength more than 20 per cent when stored in the dark for 240 days and the strength of the more heavily weighted silks did not change more than that of the silks containing less weighting or no weighting. The decrease in strength on exposure to light for 240 days varied from a little over 20 per cent to over 95 per cent depending upon the finishing treatment the silk had received. In general, the discharge printed fabrics decreased in strength to a greater extent in a given time than the corresponding printed or dyed fabrics. The fabrics containing the greatest amounts of weighting did not decrease in strength as rapidly as did some of the fabrics containing less weighting. There was no consistent relationship between the decrease in breaking strength of these fabrics and the amount of non-fibrous materials in them.

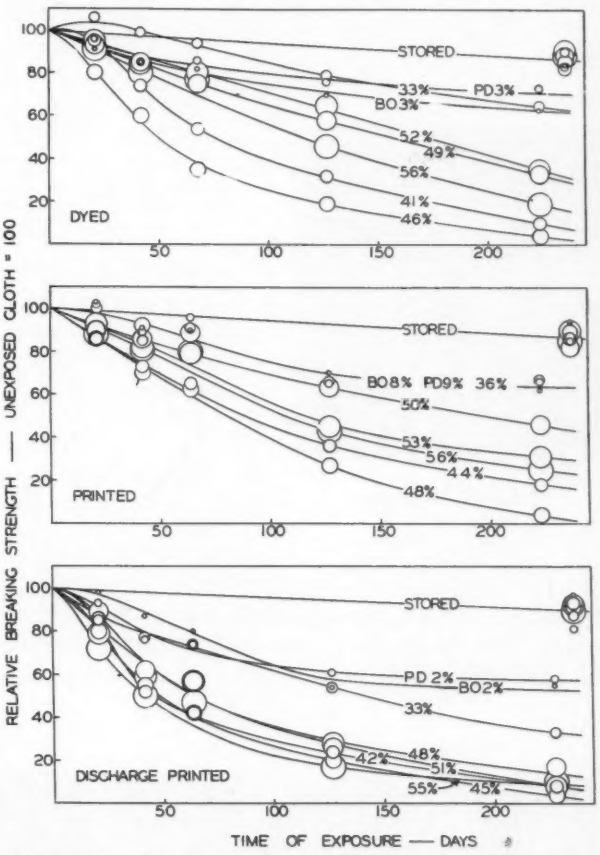

Figure 1.—Change in breaking strength of silk cloths when exposed to diffused daylight and when stored in the dark. All cloths were made from the same piece of boiled-off cloth. The "dyed" series (upper chart) included a piece of the original boiled-off silk (BO), another piece dyed but not weighted (PD), other pieces weighted to different extents and dyed. The "printed" series (middle chart) and "discharge printed" series (lower chart) included portions of each of the cloths in the dyed series which were either printed or discharge printed. The percentages given indicate the total amount of weighting and/or other non-fibrous constituents of the finished fabrics (dry basis).

[3] Manufactured by the Atlas Electric Devices Co., Chicago, Ill. Arc voltage 140, direct current, 13 amperes.

[4] Hugh M. Spencer. Laboratory methods for maintaining constant humidity. Int. Crit. Tables, *1*, 67 (1926).

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FIFTEENTH ANU

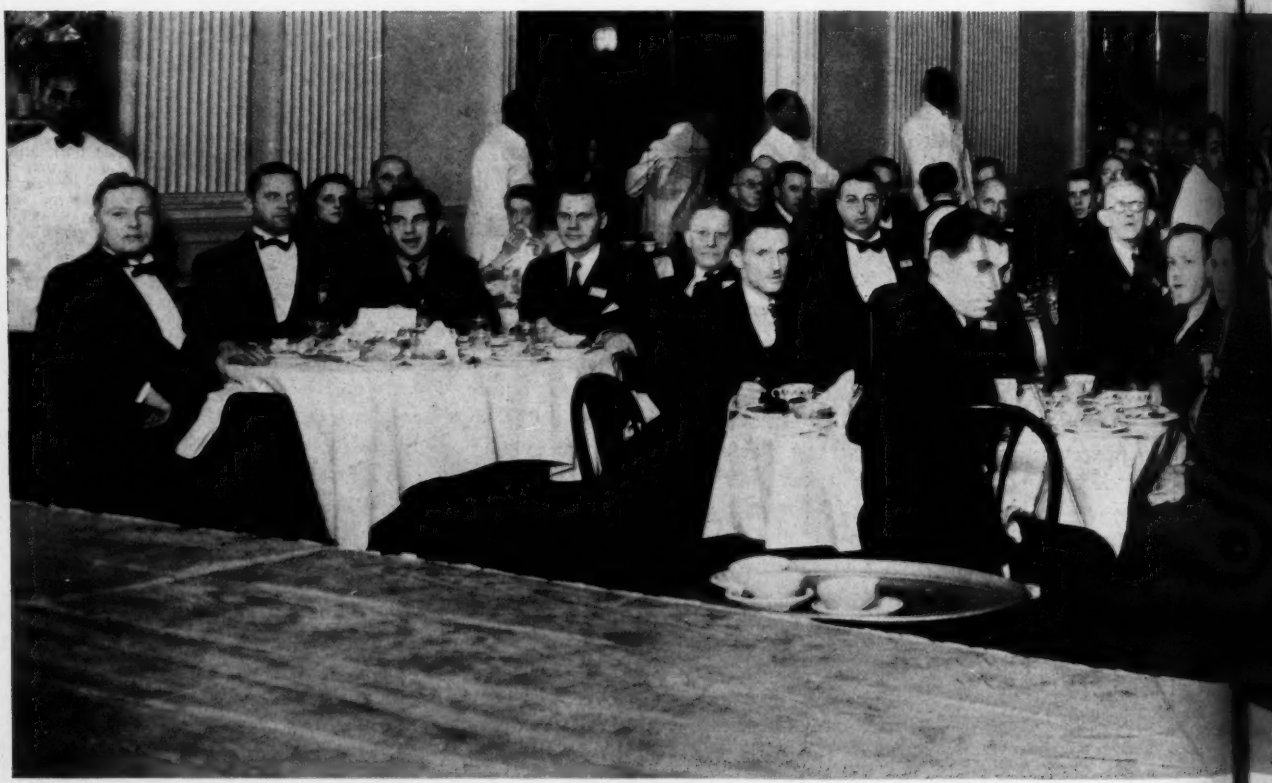
WILLIAM H. CADY
President-Elect

Representatives of all local sections attended the fifteenth annual meeting held in Chattanooga, Tenn. on December 6th and 7th. It was evident that the local committees, under the direction of William J. Kelly, Jr., general chairman, had done all in their power to make certain that every guest should not lack for want of entertainment. The excellent quality of the technical program and the strict observance of the schedule emphasized the fortunate choice of again having Carl Z. Draves serve as chairman of the technical program committee. The enthusiastic comment of those who attended the meeting left little doubt as to their appreciation of efforts which had been extended in their behalf.

CARL Z. DRAVES
Chairman,
Technical Program Committee

At the business meeting it was announced that newly-elected officers of the association for the coming year would be as follows: President—William H. Cady; Vice-president—Elmer C. Bertolet; Councilors-at-

Annual Banquet, Read House, Ch



ANUAL MEETING

Large—Harold M. Chase and Arthur E. Hirst. Officers re-elected were as follows: Vice-president — Arthur R. Thompson, Jr.; Treasurer — William R. Moorhouse and Secretary — Harold C. Chapin.

WILLIAM J. KELLY JR.
Chairman, General Arrangements Committee

Arthur R. Thompson, Jr. acted very effectively as toastmaster at the Annual Banquet and introduced, with appropriate musical numbers, the following speakers: Hon. E. D. Bass, Mayor of Chattanooga, Prof. L. A. Olney, President Emeritus and Dr. Robert E. Rose, Retiring President. They responded in a manner that was exceptionally well received. It was regretted that, due to press of business, William H. Cady, President Elect, was unable to attend the meeting.

ELMER C. BERTOLET
Vice-President-Elect

A complete stenographic report of all papers, discussions, committee reports and other events will appear shortly in the proceedings.

e, Chattanooga, Tenn., December 7, 1935

Aging Test—

(Continued from page 707)

IV. ACCELERATED AGING OF SILK

The changes in breaking strength of the 41 per cent weighted, dyed silk referred to in Figure 1 when exposed to the radiation of the glass-enclosed carbon-arc lamp under different conditions of intensity of radiation, relative humidity and temperature of the atmosphere, are shown in Figure 2. The radiation received by the fabric

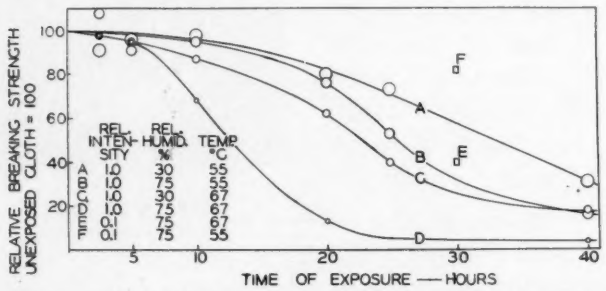


Figure 2.—Change in breaking strength of weighted silk cloth when exposed to the radiation of the glass-enclosed carbon-arc lamp under controlled conditions of intensity of radiation, relative humidity and temperature of the atmosphere. The cloth was the dyed silk containing 41 per cent weighting, Figure 1.

passed through window glass one-eighth of an inch thick as well as the glass globe of the arc. The distance from arc to cloth was 15 inches for intensity 1.0 and 49 inches for intensity 0.1. The fabric required about twice as long an exposure at the lower intensity as at the higher to produce the same change in breaking strength. A change in relative humidity from 30 to 75 per cent and in temperature from 55° to 67° C. each materially decreased the time required to produce a given change in the breaking strength of the fabric. The breaking strength decreased about as much when the fabric was exposed for 20 hours at intensity 1, relative humidity 75 per cent, and temperature 55° C. as when it was exposed for 240 days in the north window.

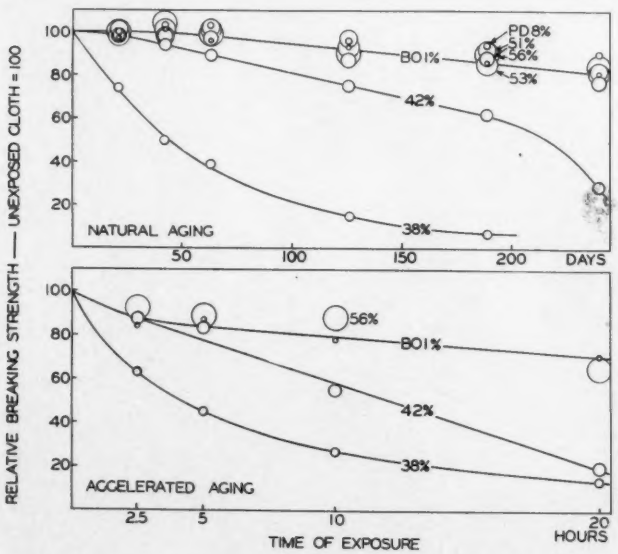


Figure 3.—Change in breaking strength of silk cloth in natural aging and accelerated aging. The same basic silk cloth was used throughout. BO indicates the original "boiled-off" silk. PD indicates the dyed but not weighted silk. The percentages given indicate the total amount of weighting and/or other non-fibrous constituents of the finished fabric (dry basis).

V. COMPARISON OF NATURAL AND ACCELERATED AGING

The experiments just described were repeated with two new series of fabrics in order to confirm the results. The natural and accelerated aging of some of these fabrics are compared in Figures 3 and 4.

The strengths of the boiled-off, "pure dye," 51, 53 and 56 per cent weighted silks finished in one mill (Figure 3) decreased very slowly and at about the same rate in the natural aging; the strength of the 42 per cent weighted decreased distinctly faster, and that of the 38 per cent weighted very much faster. Similar results were obtained with these fabrics in the accelerated aging test as shown in Figure 3.

The strengths of the fabrics which were finished in a second mill did not decrease at a rapid rate in either the natural or the accelerated aging, except toward the end of the tests. Then the 45 per cent weighted silk began to weaken rapidly in the natural aging and apparently also in the accelerated aging (Figure 4).

The results indicate general agreement in the behavior of silk fabrics in the natural aging and accelerated aging under the conditions specified when judged by the change in breaking strength. The relative behavior in the natural aging is reproduced in the accelerated aging as well as may be expected for a test of this kind.

VI. ACCELERATED AGING OF TYPICAL DRESS FABRICS

Through the cooperation of the American Home Economics Association and students of home economics in colleges in different parts of the country, samples taken

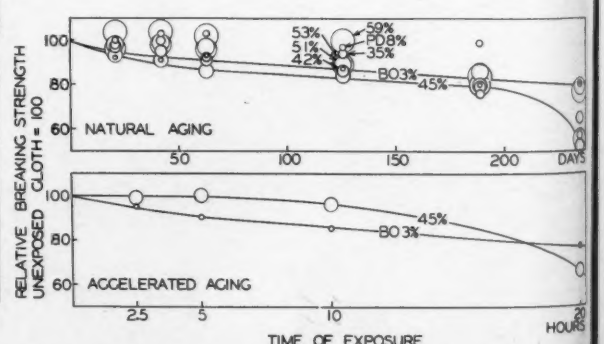


Figure 4.—Change in breaking strength of silk cloth in natural aging and accelerated aging. The same basic cloth as that represented in Figure 3 was used. Portions of it were dyed and finished by a different finishing plant than the one which finished the cloths of Figure 3. The notation used in Figure 3 applies to this figure as well.

from 23 silk dress fabrics purchased during the spring of 1930 for use in dressmaking projects were subjected to the accelerated aging test. Some of the results are given in Figure 5.[5] The pure dye[6] as well as the weighted

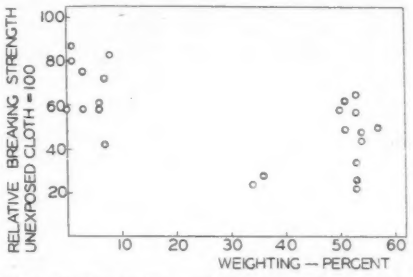


Figure 5.—Typical silk dress fabrics—breaking strength after accelerated aging in relation to the amount of weighting or other non-fibrous materials present.

silks, varied considerably in their relative stability in the test, judged by change in breaking strength. Nine out of the ten pure dye silks in the lot had more than 50 per cent of their original strength (warp or filling depending upon which showed greater change) after the 20-hour exposure. Only 4 of the 13 weighted silks had more than 50 per cent of their original strength after exposure. The two silks containing about 35 per cent weighting were among the four least stable of the weighted silks and were distinctly inferior to 8 weighted silks containing 50 per cent weighting or more. The stability of neither pure dye nor weighted silks bore any relation to the weight per square yard. The most stable of the pure dye silks weighted 0.75 oz. per square yard and the least stable 1.34 oz. per square yard.

VII. PROPOSED ACCELERATED AGING TEST

The aging test outlined below is proposed on the basis of the results obtained in this study. It is hoped that, through the application of this test to a large number of fabrics of known serviceability by laboratories regularly engaged in testing silk fabrics, that the relative stability required for various uses can be worked out.

Specimens of the cloth suitable for warp and filling breaking strength tests are exposed for 20 hours to the radiation from a glass-enclosed carbon-arc lamp, such as that of the Fade-Ometer, operated on direct current of approximately 13 amperes with the voltage across the arc approximately 140 volts. The distance from the specimens to the center of the arc is 15 inches. The specimens are enclosed in a cabinet glazed with window glass approximately one-eighth of an inch thick between the specimens and the arc. The air in the cabinet is maintained at 75 to 77 per cent relative humidity and 63° to 67° C. The breaking strength of the cloth after exposure expressed as a percentage of the breaking strength before exposure in the direction, warp or filling, showing the greater change in strength is taken to be indicative of the probable relative stability of the fabric with respect to exposure to light, heat, and moist air.

[5]Detailed information concerning the constructions and properties of these fabrics is being incorporated by Dr. R. K. Worner of this bureau in a report on the serviceability of dresses made from the fabrics.

[6]Silk containing less than 10 per cent of nonfibrous materials. See Federal Trade Commission "Statement by the Commission, Trade Practice Conference, Silk Weighting" of June 18, 1932.

MEETINGS, NORTH CAROLINA STATE COLLEGE STUDENT SECTION

THE North Carolina State College Student Section had as its guest during the week ending November 23, George Searell, representing the Jacques Wolf Company. Mr. Searell gave a series of four lectures on the subjects, "Monopol Oil and Other Compounds Used in Textiles," "Hydrosulfites and Strippers," "Silk Processing," and "Printing Gums." The Section hopes to have Mr. Searell back again in the near future, as well as other lecturers on various textile subjects.

Respectfully submitted,

A. E. SHUMATE, *Chairman.*

MEETING, NEW YORK SECTION

THE regular monthly meeting of the New York Section was held at the Elm Golf Club on Friday evening, November 22nd, at 8:00 P. M.

Dr. Harvey Alexander Neville, Associate Professor of Chemistry, Lehigh University, was the principal speaker at this meeting. He spoke on "Surface Chemistry and Dyeing," illustrating his talk with lantern slides.

Dr. Jerome Alexander led the discussion at the close of the address. Our chairman, Ephraim Freedman, presided and introduced the speaker and the leader of the discussion.

Henry Herrmann discussed the Annual Meeting which is to be held at Chattanooga, Tenn. It was again indicated that approximately ten members of this section would attend the meeting.

The total attendance was about fifty.

Respectfully submitted,

P. J. KENNEDY, *Secretary.*

CALENDAR OF COMING EVENTS

* * *

Meeting, New York Section, Friday, January 31, 1936, Elm Golf Club, Paterson, N. J.

* * *

Complete Stenographic
Reports of the
Annual Meeting
will appear in
the Proceedings
in the near future

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SELLING RESEARCH

ACCORDING to an editorial in the current issue of *Textile Research,* the most difficult problem to be solved by the U. S. Institute for Textile Research is not a research, but a merchandising problem—the sale of the research idea to the industry. It is further stated that at the recent annual dinner of the Institute four examples of recent research findings were described, the general utilization of which by mills for which they are adapted would result in large annual economies. "They are available to any manufacturer who has the intelligence to apply them. Must every 'doubting Thomas' have such a gift forced on him before he will support research co-operatively?"

The editorial further indicates that if the textile industry remains unconvinced of the value of scientific research (and there should be no doubt as to its value) then it will become necessary to make this particular problem the subject of research itself in order to sell the research idea to those textile men who should have the ability to utilize it advantageously. And, in answer to this—"Naturally, the Institute hesitates to embark upon such a study, because it could hardly fail to be interpreted as a serious indictment of the textile industry for lack of intelligence, progressiveness and adventuresomeness."

Even in the face of such an indictment would not the ultimate results be worth it? Or perhaps there is some other method available which would escape this indictment.

● AIR HYGIENE FOUNDATION

Air Hygiene Foundation of America, Inc., has been formed by a large group representing various industries, with headquarters at Thackeray Ave. and O'Hara St., Pittsburgh, Pa. The purposes of this organization are to conduct investigations of and to stimulate research on problems in the field of air hygiene and to gather and disseminate factual information relating thereto. It will also cooperate with and assist other agencies active in this field and will collaborate in the coordination of such research efforts. A comprehensive investigation has been begun at Mellon Institute of Industrial Research, Pittsburgh, under support of Air Hygiene Foundation of America, in which the hygienic, technologic, and economic aspects of air contamination, especially by dust in the industries, will be studied.

● OCTOBER CHEMICAL EXPORTS

United States exports of chemicals and allied products during October reached the highest value recorded for several years, according to an analysis of preliminary statistics by C. C. Concannon, Chief of the Commerce Department's Chemical Division. Every major item in the list, except sulfur, shared in the gain, he stated, with notable increases being made in shipments of naval stores, coal-tar products, particularly benzol and dyes, and potash fertilizers.

The total value of chemical exports aggregated $13,570,000 in October, compared with $12,030,000 during the preceding month, and $10,301,000 for October last year, statistics show.

Shipments of coal-tar products to foreign countries in October were valued at $1,328,400, compared with $904,250 for the same month of last year. In this group bensol exports increased from 36,700 to 1,970,500 gallons and dyes, colors, stains, etc., doubled in quantity to 1,816,000 pounds.

● CANADIAN CHEMICAL MARKET

A substantial two-way chemical trade exists between the United States and Canada, statistics compiled in the Commerce Department show.

In 1934, the latest year for which detailed statistics are available, United States shipments to Canada by grand groups were as follows: Coal-tar products, $1,602,000; sodium compounds, $1,421,000; pigments, paints and varnishes, $1,787,000; fertilizers, $1,647,000; and sulfur, $2,650,000. The aggregate value of these exports, amounting to $9,107,000, represents a gain of approximately 33 per cent as compared to the preceding year but a 40 per cent decrease as against 1929.

In addition to the chemical products mentioned above Canada obtains naval stores, gums and resins from the United States exceeding $1,000,000 in value per annum, as well as large quantities of medicinals, toilet requisites, pyroxylin products, printing inks, explosives, and a number of miscellaneous chemical products, it was stated.

United States imports of chemicals from Canada consist largely of electro-chemical products and included the following items in 1934: acetic acid, $1,846,000; sodium cyanide, $1,140,000; and fertilizer materials, $3,798,000.

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(Continued from page 704)

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● MONEL DISPLAY

Among the items in the display of the International Nickel Co. at the Chemical Industries Exposition which were of interest to readers of the REPORTER was a Monel Metal pail which had been sold to a dyeing and finishing concern ten years ago and which had been used daily handling dyestuffs and chemicals commonly used in a dyehouse. It was stated that galvanized pails subjected to the same service do not last more than a few months. A Monel Metal dyestick was also on display which had been used for 21 years. It was stated that other dyesticks in service equally as long are still being used. It is claimed that throughout their long service, Monel Metal dyesticks have successfully withstood the corrosive attacks of dyestuffs, salt solutions and other chemicals. An illustrated catalog of Monel Metal and nickel information is available.

Absorption of Dyestuffs By Viscose*

Stretched Yarns and Their Affinity for Dyestuffs

By A. M. PATEL

VERY little work seems to have been carried out on the absorption of dyestuffs by viscose. Wilson and Imison (J. Soc. Chem. Ind., 1920, P. 322), came to the conclusion that the evenness of shade at 50° C. varies according to the molecular weight of the dyestuff used and that the orientation of the groups in the molecule and their nature have no effect. It was shown that dyestuffs of low molecular weights give very even results under normal dyeing conditions even though the rayon may vary considerably. Researches carried out recently do not seem to support the conclusions arrived at by the above investigators. The colloidal condition of the dyestuffs is the paramount factor in the diffusion of the dye micelles into the intermiceller spaces of the regenerated cellulose. In a paper published in the AMERICAN DYESTUFF REPORTER, September 10, 1934, the author has shown that those dyestuffs which have a very high rate of diffusion give level results on viscose, whereas, those with very low values, should never be used with rayon.

Various attempts have been made by dye manufacturers to put on the market various preparations of dyestuffs containing metals in complex combination which are claimed to dye level shades on commercial viscose of irregular properties. Suggestions have also been made for treating viscose with various substances for either increasing or decreasing its dye affinity. They cannot however be translated into successful commercial propositions.

Experiments have proved that the substantivity of the direct dyes for viscose depends upon various factors such as the concentration of the dye bath, the nature and amount of the inorganic substances or the protective colloids, the temperature of dyeing and the colloidal nature of the dyestuffs. The amount of the dye absorbed increases with the increase of either the dye concentration or the addition of greater amounts of inorganic salts such as sodium chloride or sulfate to the dye bath. The addition to the dye bath of a colloidal electrolyte such as soap or gelatine which carries the same charge as the dye micelles decreases the absorption of the dye. The temperature of dyeing viscose is of significance in the absorption of dyestuffs by regenerated cellulose. It is found that the lower the temperature of dyeing, the greater is the absorption of the dye.

Viscose manufactured under different conditions has been found to absorb the same amount of the substantive dye at equilibrium. It has also been found that those colors which are more readily taken up by viscose give level shades, whereas those whose rate of diffusion into the capillary spaces of the absorbent is slow are chiefly responsible in producing unequal shades.

It has been stated before that one of the causes of the unlevel dyeing of viscose is the unequal tension to which the yarn is subjected either during spinning or during the subsequent treatment. In order to study the absorption of dyestuffs by the viscose yarn subjected to varying tensions, a number of experiments were carried out, the results of which are given in Table I, II and III and which refer to viscose manufactured by different concerns.

It can be seen from these tables that the absorption of the dyestuff decreases with the increasing tension applied to the yarn. There is, however, no linear relationship between the two factors. Viscose manufactured by different firms absorbs varying amounts of the dyestuffs and is stretched to different degrees by the same amount of tension. The results show the variation of the dyestuff absorbed by the same viscose stretched to different extents.

In considering these figures, it should be remembered however, that the amount of dye absorbed by viscose yarn subjected to varying tension refers to that taken up in five minutes. It was expected that if experiments were

TABLE I (VISCOSE A)

Dyestuff = Chlorazol Sky-Blue FF.05g/1.
Sodium Chloride = 5.0 gms./1.
Temperature of Dyeing = 80°C.

Tension in gms.	*% stretch of yarn in cms.*	*% dye absorbed in five minutes.*
0	3.4	0.44
5	6.0	0.284
10	7.0	0.260
20	9.0	0.240
36	10.9	0.221
47	11.8	—

N.B.—The first horizontal column indicates the extension of the yarn when wetted in water.

*Reprinted from the Silk Journal & Rayon World.

TABLE II (VISCOSE B)

N.B.—The conditions of dyeing are the same as in the preceding table.

Tension in gms.	*% stretch of yarn in cms.*	*% dye absorbed in five minutes.*
0	3.6	0.42
5	6.4	0.25
10	8.3	0.22
20	11.5	0.193
30	13.3	0.181
40	15.2	0.170

TABLE III (VISCOSE C)

N.B.—The conditions of dyeing are the same as in the preceding tables.

Tension in gms.	*% stretch of yarn in cms.*	*% dye absorbed in five minutes.*
0	4.5	0.49
5	8.6	0.28
10	10.6	0.22
20	14.2	0.18
30	17.7	0.165
40	22.1	0.153

TABLE IV (VISCOSE A)

Time in minutes.	*% dye absorbed.* 0 *gms. tension.*	20 *gms. tension.*
5	0.44	0.24
10	0.76	0.35
20	1.00	0.52
30	1.09	0.67
60	1.30	0.92
120	1.43	1.24
180	1.42	1.33
240	1.43	1.40

TABLE V (VISCOSE B)

Time in minutes.	*% dye absorbed.* 0 *gms. tension.*	20.0 *gms. tension.*
5	0.42	0.193
10	0.65	0.30
20	0.85	0.42
30	1.00	0.52
60	1.23	0.75
120	1.42	1.01
180	1.40	1.20
240	1.42	1.35
360	1.42	1.40

TABLE VI (VISCOSE C)

Time in minutes.	*% dye absorbed.* 0 *gms. tension.*	20.0 *gms. tension.*
5	0.49	0.18
10	0.74	0.32
20	1.06	0.58
30	1.30	0.75
60	1.66	1.06
120	1.82	1.43
180	1.80	1.67
360	1.84	1.86

carried out till equilibrium absorption was attained, no difference would have been found in the amount of the dye absorbed. The results given in Tables IV, V and VI prove the correctness of this consideration. The conditions of dyeing were the same as in Tables I, II and III.

From Tables IV, V, and VI, it can be seen that with increasing time, the difference between the absorption of the dye by normal and stretched viscose yarn becomes less and at equilibrium absorption, the amount becomes equal. It should, however, be noted that in practice, the time of dyeing of viscose would be considerably shorter. From the results, it is clear that many of the difficulties in the unlevel dyeing of viscose would disappear if it were dyed to equilibrium. Such a practice however cannot be recommended to the dyer as a prolonged treatment of the rayon fabric in the dye bath might be deleterious to the tensile properties of the material. The yarn was stretched more than it would be under ordinary circumstances. In those cases where a slight variation in tension was introduced in the yarn, the unlevel shade would soon have disappeared if the viscose had been dyed for a little longer. The viscose solution is colloidal in nature with a negative charge acquired by the preferential absorption of the hydroxyl ions. The ammonium chloride test applied to the viscose solution in order to determine its exact ripeness depends upon the fact that the inorganic substance is a coagulant for the negatively charged viscose solution and the rate of coagulation is easily controlled. In the presence of a powerful coagulant such as sulfuric acid, coagulation is instantaneous and it is very difficult to determine the exact amount of the acid. This is the reason why acid is used in the coagulating bath where instantaneous coagulation is necessary and not in the determination of the ripeness of the viscose solution.

Very little work seems to have been done on the colloidal properties of the viscose solution and the effect of various substances on the rate of coagulation. The rate at which the solution is coagulated is mainly responsible for the properties of the yarn and it is suggested therefore that a careful study of the colloidal aspects of the various processes in the manufacture of viscose would yield fruitful results.

Technical Notes from Foreign Sources

Azo Dyestuffs (Naphthol AS Series)

German Patent No. 500,176 (*June* 30, 1930)—*I. G. Farben-Ind. A.-G.*—The second components of this procedure are the arylamides of 2-hydroxy-3-naphthoic acid, or of beta-keto-carbonic acids, which possess affinity for vegetable fibers. The first component is a halogenated derivative of 1-3-dimethyl-5-amino-benzene (sym-xylidine). The products will usually be pigments, and may be generated by development upon the fiber as usual, or formed as such in substance, or formed and precipitated upon a suitable substratum, as lakes.—Several examples are given.

Azo Dyestuffs (Pyrazolone-Azo Series)

German Patent No. 493,128 (*March 7*, 1930)—*I. G. Farben-Ind. A.-G.*—The process here protected consists in coupling the diazo salt of any desired amine to pyrazolone-sulfocarbonic acid esters, the carboxylkyl or car-boxaryl radical being attached to the pyrazolone carbonic adjacent to a nitrogen, and the sulfonic radical being located in a cyclic radical attached to the other nitrogen of the ring, which is adjacent to the keto carbon. The hydrocarbon radical may bear other substituent groups beside the sulfonic group. Alternately, the carboxyl group may be in the free state at the time of coupling, and afterward esterified. If the amines serving as first component are anthranilic acid, o-aminophenol, their derivatives or homologues, or compounds with similar groupings, the dyestuffs or dyeings produced from them may be afterward afterchromed.

Azo Dyestuffs (Naphthol AS Series)

German Patent No. 498,535 (*May* 23, 1930) (*addition to G. P. No.* 491,349 *of Jan.* 26, 1927)—*I. G. Farben-Ind. A.-G.*—Set in the original patent and its supplement, G. P. No. 496,746, protect the use of mono-aroylated 1-3-phenylene-diamines, substituted in the 4- and 6-positions by methyl or oxyalkyl groups, as first components, to be diazotized and coupled to the arylamides of 2-hydroxy-3-naphthoic acid. The present procedure extends the reaction to include those mono-aroylated 1-3-phenylene-diamines, which possess, in the ortho position to the amino groups, a halogen atom (in one position) (and a methyl or alkoxy group (in the other position), or halogen atoms in each position, and whose imide hydrogen (the residue in the aroylated amino group) may be replaced by an alkyl or aralkyl residue.

In the example given, the cloth is padded with the beta-naphthylamide of 2-hydroxy-3-naphthoic acid, and developed in a diazo-solution prepared from 1-amino-2-chlor-4-methyl-5-benzoylamino-benzene. The dyeing is a clear red, very fast to kiering.

Another possibility described consists in the conversion of suitable osazones, as those of the esters of dihydroxy-tartaric acid, into the dyestuffs, usually by merely heating gently.

The products are dyestuffs for wool, and dye in level and pure tones. The peculiar effect of their condition as esters of carboxylic acids seem to be, that they dye more level, and the dyeings are faster to light, than is the case with the unesterified products. Seven examples are given.

Azo Dyestuffs (Naphthol AS Series)

German Patent No. 491,512 (*February* 25, 1930)—*I. G. Farben-Ind. A.-G.*—As with most of the recent patents relating to the Naphthol AS series, the present procedure protects new first components, to be used upon any of the arylamides of 2-hydroxy-3-naphthoic acid. The components here referred to are such derivatives of 1-naphthylamine-4-5-dicarbonic acids, as have been condensed in the two carboxyl groups, with loss of the acid hydroxyls, with an aromatic amine, whose NH_2 group loses its two hydrogens (more exactly, the amine may be ammonia, an aliphatic, or an aromatic amine, or an aralkyl amine). Such components may be prepared, e.g., by heating the anhydride of the dicarboxylic acid with ammonia or the amine.

For example, cotton yarn is padded as usual with a solution of the 2'-5'-dimeth-oxyanilide of 2-hydroxy-3-naphthoic acid, and developed in a diazo bath of 1-amino-4-5-naphthalimide. By the usual working, rinsing, soaping, and drying, a handsome bordeaux is obtained, very fast to light and washing.

Azo Dyestuffs (Naphthol AS Series)

German Patent No. 491,349 (*February* 19, 1930)—*I. G. Farben-Ind. A.-G.*—The usual Naphthol AS second components are employed in the procedure here protected. The first components are such 1-2-4-asymmetric m-xylidines, as also contain in the 5-position an amino group substituted by a benzoyl radical, simple or substituted, if desired, by an alkyl radical.

In one of the several examples given, the amine is one of the simpler ones, 1-amino-2-4-dimethyl-5-benzoylamino-benzene. The dyeings obtained from it, with the alpha-naphthalide of 2-hydroxy-3-naphthoic acid, are of the frequent bluish-reds.

Vat Dyestuffs (Benzanthrone Series)

German Patent No. 501,019 (*June* 27, 1930)—*Gesells. f. Chem. Ind. in Basel*—When 2-2'-dibenzanthronyl or dibenzanthrone are used as such as vat dyestuffs, the tones upon cotton are violet blue, and not fast to water. These compounds as here considered are converted to chlorine derivatives, by heating (140°-150° C.) with anhydrous ferric chloride in presence of a suitable medium (trichlor-

benzene) for some hours. When the vigorous evolution of HCl has ceased, the solvent is blown off with steam, the residue extracted with dilute HCl to remove iron compounds, washed, and dried. The yield is good. The products dye cotton in genuine blue tones, not sensitive to water.

Vat Dyestuffs (Benzanthrone Series)

German Patent No. 490,723 (*February* 6, 1930)—*I. G. Farben-Ind. A.-G.*—The syntheses specified by the present patent consists in treating N-benzanthronyl-pyrazolanthrones with alkaline condensing agents. For example, 4-methyl-pyrazolanthrone, when condensed with bz-1-brombenzanthrone, yields an N-bz-1-benzanthronyl-4-methyl-pyrazolanthrone, of m.p. 332°-333° C., when crystallized from nitrobenzene. This product, when fused with alcoholic potash at 100° C., condenses to a dyestuff, in the paste, form a bluish-green, in the dry form a black, solid, Its vat is greenish-blue, with a blue-green "bloom". Cotton is dyed by it a handsome greenish blue.

Six examples altogether are given.

Vat Dyestuffs (Carbazole Series)

German Patent No. 491,428 (*February* 17, 1930)—*I. G. Farben-Ind. A.-G.*—The substances described in this procedure as the starting-point of the process are complicated carbazoles, which may be formulated thus: two anthraquinone nuclei, fused to a carbazole linkage by uniting the 1- and 1'- positions by an amino group, and the 2- and 2'- positions by direct union, with the following substitutions; in one of the anthraquinonylene residues, the 5-position in reference to the NH linkage (1-), and the 4' position on the other anthraquinonylene residue, carrying each an amino group substituted by an acyl radical. Such products are saponified under mild conditions, e. g., by heating with conc. sulfuric acid at temperatures between 35° and 50° C., though the temperature and concentration of acid may each be varied—this naturally altering the time factor, which lies between 1½ and 5 hours. The course of the reaction is followed by dilution of a sample and treating with nitrite, the diazo salt of even the mono-amino product being very soluble in water; as soon, therefore, as the test-portion, diluted and treated with nitrite, dissolves completely, the reaction is ended. Evidently there is a difference in the rate of saponification of the two acylated amino-groups, due doubtless to the location of the groups concerned in reference to the point establishing the carbazole linkage, as one, for example, speaks of the 5-amino-4'-acylamino-1-1'-anthrimide-carbazole obtained (it is to be recalled that the saponification is desired upon only one of the two possible points). When the reaction is finished, the mixture is cooled, poured upon ice, filtered, and the solid dried. Yields are excellent and the purity satisfactory. The products are usually practically insoluble in toluene, chlorbenzene, etc., slightly soluble in hot naphthalene or nitrobenzene, and soluble in conc. sulfuric acid. They are of themselves red vat dyestuffs, but are perhaps as useful for further working up into other products.—Three examples are given.

Vat Dyestuffs (Benzanthrone Series)

German Patent No. 492,274 (*February* 24, 1930)—*I. G. Farben-Ind. A.-G.*—The products from condensation of benzanthronyl-pyrazol-anthrones are here treated with halogen or halogenating agents. For example, a suspension of benzanthrone-pyrazol-anthrone (see G. P. No. 490,723) in nitrobenzene is treated with sulfuryl chloride (equal amounts) and the mixture heated at 70° C. for three hours. HCl is vigorously evolved. The mixture is then cooled, diluted with alcohol, filtered, and washed with alcohol, then with water. The product dyes cotton in clear violet-blue tones of great fastness. It is apparently a dichlor-product. Some of its characteristics are as follows: a dark-blue-violet powder, sol. in hot nitrobenzene (sparingly) with a violet-blue color, depositing on cooling in red-violet crystals. Soluble in conc. sulfuric acid with a gray-violet color, which changes to green on slight dilution; with greater dilution the product is precipitated in bright red-violet flakes. The hydrosulfite vat is greenish-blue.

Vat Dyestuffs (Benzanthrone Series)

German Patent No. 492,275 (*February* 24, 1930)—*I. G. Farben-Ind. A.-G.*—A procedure related to the preceding (G. P. No. 492,275), employing the same substance, benzanthrone-pyrazol-anthrone, as the starting-point. In this case, the procedure protected is that of nitration, with possible reduction of the nitro group formed. For example, the anthrone is suspended in glacial acetic acid, nitric acid of 48° Bé. added, and the mixture stirred for 15 hours at the ordinary temperature. The product is filtered off, washed, and dried. It forms a blackish-violet powder, soluble in conc. sulfuric acid with a greenish color, which on slight dilution becomes yellowish-green, finally precipitating in violet flakes. The hydrosulfite vat is blue and dyes cotton a handsome clear green, which on treatment with chlorine changes to gray or black. A similar product is obtained if the nitration is carried out in nitrobenzene as a medium.

Three examples altogether are given.

Use of Colorimeter TCB in Determination of pH and of Ageing of Solutions of Chromium Salts

M. Lesbre—TIBA 11, 163 (1933).—Note has been made, in these columns, of different sections of an interesting paper by Lesbre, describing his study of direct cotton dyestuffs in the process of dyeing, in a most interesting and exact way. The rather lengthy title of this paper, as given above, will be explained by the fact that it forms an appendix to the above-mentioned study, in which the author gives exact details of his method of obtaining some of his results.

Under (a) (determination of the pH of solutions), he speaks of the use of Hellige's apparatus (colored glass standards). In case there are not any data already indicating the approximate pH value, he recommends, first, the determination of the value to a half-unit by means of Merck's universal indicator, and second, the further determination of the figure to a closeness of 0.2 unit. With the photo-colorimeter mentioned, and Merck's indicator, used thus in conjunction, very close determinations may be made, to within 0.1 unit. The photo-colorimeter was used in connection with a 220 volt alternating current, in series with a balancer maintaining the current at 2.5 amperes. The photo-electric cell (potassium type) was inserted into a circuit whose voltage was varied definitely according to the nature of the monochromatic screen being employed at the time, in such a way as to maintain a voltage about 4/5 of the critical voltage of illumination of the cell. Under these conditions, the author found that the light-spot thrown by the galvanometer was displaced by an amount sufficient to eliminate the errors of reading on the scale, practically entirely. The author also prepared a series of buffer solutions of a pH varying from 3.5 to 10.0, by fractions of 0.2 units. The table of results added (table XXXIX) gives the results of his work for violet, blue, green, yellow, orange, and red, in values varving from pH 3.0 to 10.0, by steps of 0.2.

The author adds, that, with a little experience, one can determine the pH value by the photo-colorimetric method as exactly as with the more pretentious electrometric apparatus, and that the colorimetric method has the advantage of greater rapidity.

As to the second part of the paper (a study of the evolution of a solution of a chromic salt), the author points out the well-known fact that solutions of such salts undergo a gradual change in nature, toward a state of equilibrium, definite for a given concentration and temperature. Of the two methods for determination of the extent of this change, one consists in observation of the variations in the electro-conductivity of the solution, until its value becomes constant. This is the exact method. The other, less exact, but much more rapid, consists in following up the variation of the index of flocculation under the influence of an alkali. This method, beside being less exact, can be used only within a certain range of concentration. The author, however, has studied the method from the colorimetric point of view, following up the variations in color, corresponding to successive stages of alteration, by means of the photo-colorimeter. In this case, the light source was a Phillips lamp of 250 watts, run upon a 110 volt current, kept constant by a regulator of the type used for Nernst lamps. The salt of chromium studied was the green chloride, at several different concentrations. The results are given in Tables XL, XLI, and XLII, and are discussed in a general way.

Wool Dyestuffs (Anthraquinone Series)

German Patent No. 491,424 (*February* 24, 1930)—*I. G. Farben-Ind. A.-G.*—The process here protected consists in the esterification of anthraquinone derivatives, which possess a hydroxyl group or groups in the beta position, with sulfuric chlorhydrine (chlorsulfonic acid), the acid sulfuric esters being formed. The reaction is carried out in the presence of tertiary organic bases (pyridine, quinoline, dimethylaniline, etc.), which neutralize the HCl liberated, without themselves entering into reaction in any other way. Such hydroxy-anthraquinones as alizarine, Alizarine Bordeaux, etc., are susceptible to such treatment, while Chrysazine, Anthrarufine, etc., are not.

The products are stable toward even strong alkali, but are easily saponified by even weak mineral acids. They dye wool strongly, and the dyeings, when made upon mordants, or afterchromed, give shades somewhat faster to fulling, in some cases, than do the original, unesterified substances. The products can, of course, be employed for dyeing cotton, or for the preparation of lake pigments.

Four examples are given.

Quinizarine-Sulfonic Acid (Intermediate)

German Patent No. 492,000 (*February* 15, 1930)—*I. G. Farben-Ind. A.-G.*—The present procedure describes the preparation of the boric acid ester of quinizarine by dissolving the latter, two parts, and one part of crystallized boric acid in 10 parts of 20 per cent oleum, this mixture being then treated with ten parts of 65 per cent oleum and some mercuric sulfate, and the whole heated at 170°-180° C. until sulfonation is complete. The mixture is poured into water, and the quinizarine-6-sulfonic acid is salted out. It is valuable as an intermediate for further syntheses.

It seems very strange that sulfonation should take place in the beta position, in the presence of a mercury compound.

Vat Dyestuffs (Pyranthrone Series)

German Patent No. 493,705 (*March* 11, 1930)—*Gesells. f. chem. Ind. A.-G. in Basel.*—The process cited here consists in the heating of halogenated pyranthrones with phenols, in the presence of substances which neutralize mineral acids In one example given, 100 parts of phenol and 6.5 parts of anhydrous sodium acetate are boiled together for a short time, cooled, mixed with 5 parts of trichlor-pyranthrone, and the mixture heated to boiling under reflux for six hours, becoming at first thick, then gradually thinner, and changing in color from orange to orange-red. The mixture, on cooling, is mixed with 200 parts of alcohol, the dyestuff which is precipitated filtered off, washed with much hot water, and dried.

The products are orange to red or bordeaux, or brown, contain some halogen, and dye cotton from the vat in fast tones. They are soluble in the solvents in which vat dyestuffs are usually soluble, and in about the same degree—conc. sulfuric acid, boiling xylene, nitrobenzene, aniline, etc.—about as usual. By using other phenols, other products are obtained.

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3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

Answers

29—Is there any known method for stripping sulfur black dyed cotton, or sulfur dyed cotton of other colors in the presence of wool without injuring the wool? The fabric particularly in mind is a sulfur dyed cotton warp with a worsted filling.—**P. B. M.**

Answer No. 2—The writer once had occasion to dye a light henna shade on a shoddy wool fabric and the experimental work done in connection with that project may be of interest. The fabric was first stripped with sodium sulfoxylate formaldehyde, dyed and perched. Upon examination numerous black specks were found which proved to be about 90-95 per cent sulfur black dyed cotton. It was evident that a stripping agent of a reducing nature had no effect on the sulfur black and so an oxidizing agent was used as follows:

One skein each of white wool and sulfur black dyed cotton was treated in a bath made up in the following concentration:

4½ lbs. potassium permanganate—100 gals.
1 hour cold
Drained and washed
7 lbs. sodium bisulfite
1½ pints oil of vitriol } 100 gals.
1 hour cold
Rinsed thoroughly and dried

The sulfur black dyed cotton stripped to almost a clean white and the wool was not materially tendered nor harshened. As one of the difficulties in dyeing shoddy goods is to get as heavy a shade on the cotton specks as on the rest of the fabric it becomes evident that it is preferable not to strip the sulfur black to a white but to a light grey. Accordingly one-half the concentration of the above bath was used which stripped the sulfur black to the desired grey.

The following procedures were then tried in the dyehouse with results as noted:

PROCEDURE NO. 1

20 yards shoddy-wool cloth; finished weight, 18 ozs.
2 lbs. potassium permanganate—100 gals.
1 hour cold
Drained and rinsed
7 lbs. sodium bisulfite
¾ pint oil of vitriol } 100 gals.
1 hour cold
Washed thoroughly
Required per cent of sodium sulfoxylate formaldehyde to strip the shoddy
2 per cent formic acid
Brought to boil in one-half hour; boiled one-half hour
Rinsed
5 per cent ammonia (to neutralize formic acid thus making it easier to dye cotton specks)
Brought to boil in one-half hour; boiled 10 mins.
Washed
Dyed

Results:—All the sulfur black dyed threads were stripped. The cloth was tendered more than desired.

PROCEDURE NO. 2

15 yards shoddy-wool cloth; finished weight 18 ozs.
2 lbs. permanganate—100 gals.
1 hour cold
Drained and washed
Usual per cent of sodium sulfoxylate formaldehyde
8 per cent formic acid (4 times the usual amount but determined as the most effective)
Brought to boil in one-half hour; boiled one-half hour
Rinsed
5 per cent ammonia
Brought to boil in one-half hour; boiled 10 mins.
Rinsed
Dyed

Results:— Sulfur black threads were all stripped. Cloth was tendered about the same as in Procedure 1. The shade was a little dull due to the fact that the shoddy wasn't stripped quite thoroughly. Further stripping would probably have tendered the fabric too much.

In both of the above procedures a sulfonated alcohol was used as a wetting-out agent in the permanganate bath.

The writer believes that further experimentation along these lines will result in a procedure that will

prove satisfactory and desires to communicate through the Open Forum with anyone who may have done any work along this line.—E. A. P.

Unanswered Questions

27—Is there any satisfactory method for detecting the presence of sulfur black on a dark blue dyed fabric when a small amount of sulfur black has been added to the sulfur blue to deepen the shade?—**P. B. M.**

28.—I am in need of some information in regard to the dyeing of cotton ducks with vat dyes.

The method I am using is the regular pigment pad method, reduction being carried out subsequently in jigs.

In padding 8 oz. and 10 oz. army ducks what density top and bottom padder rolls would be best adapted? Our pad rolls at present contemplated are bottom, 20 plastometer, top 70 plastometer. We have found that equal density rolls give a shading from face to face. The face next to bottom roll being much darker under this condition.

Should this fabric pass under an immersion roll in the pad box before entering the nip, or, will the method use on light weight goods, passing the cloth directly into the nip having the bottom padder roll partially immersed in the pad box and a spray pipe on the top surface to feed the dye liquor, be best adapted to this type of fabric?

Information in regard to the above will be highly appreciated.— **A. M. L.**

32—I am experiencing some difficulty with knitting yarns in that they are harsh after dyeing to such an extent that they do not possess the necessary spring or elasticity to permit them to knit the same width as the natural grey yarn. In other words, material knitted from the dyed yarn under apparently the same conditions, comes from the machine wider than that knit from grey yarn. It is further a fact that I find that dyed and bleached yarn spreads out in the knitting machine as compared with that which is unbleached and which has not been specially treated in any way.

How can this be overcome, should it best be done through the use of softeners, or, through modification of the bleaching and dyeing process?

Any suggestions will be appreciated.—**W. P. B.**

● NATIONAL RELEASES

National Aniline & Chemical Co. announces release of bulletins on the following products:

National Erie Garnet W D—an addition to the National line especially intended to provide a color suitable for white discharge work on rayon and on pure and tin-weighted silks. In this respect it is superior to National Erie Garnets B and RB. In addition to the uses noted above, this product is said to be of interest to the union dyer as it will cover animal fibers yellower but fully as strong as vegetable fibers. Bulletin No. 193.

National Diazine Bordeaux 2 B L—a new addition to the National line of developed dyes which produces with National Developer B, bordeaux and wine shades said to be of good fastness to water, washing and cross dyeing, and of excellent fastness to sea water, perspiration and rubbing. Because of the ease with which it may be discharged with hydrosulfite, this product is especially recommended by the manufacturers as a ground for white and colored discharges. It is stated that acetate effects are left practically clear and that the shade is unaffected by any of the usual metal dyeing equipment. Bulletin No. 197.

National Carbanthrene Blue B C F Double Paste—a vat blue especially developed for pad-jig application. It is stated that the great ease with which this product reduces in the jig materially facilitates development of the shade and reduces considerably the time element of this operation. It is said that this product also readily lends itself to the dyeing of raw stock and yarns in circulating machines or to use in continuous machines. It is further said that this product possesses all of the excellent fastness properties of the B C S Double Paste, having very good fastness to chlorine and excellent fastness to practically all other color destroying agents. It is also available in powder form as National Carbanthrene Blue B C F Powder. Bulletin No. 199.

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED — Dyestuff Salesman—Will consider new connection first of year with reputable manufacturer Dyestuffs and allied products. Associated past several years with well known firm. Have excellent textile plant contacts, will furnish references as to selling ability, character, etc. Southern New England territory preferred. If interested will arrange for personal interview. Write Box No. 873, American Dyestuff Reporter.

TEXTILE RESEARCH DIRECTORS! Can you use a man with a thorough technical background for development and research? M.I.T. '35. No actual textile experience, but I want an opportunity to use broad organic training towards solution of textile chemical problems. Write Box No. 874, American Dyestuff Reporter.

Small Chemical factory seeks connection with chemical or willing to purchase processes—chemical or dyestuff line. We have good connections with printers, finishers and dyers. Please give some indication of product in your answer. Answers will be held strictly confidential. Write Box No. 875, American Dyestuff Reporter.